REMARKS

The specification has been amended as needed so as to take care of the formal requirements expressed in the Official Action.

Reconsideration is respectfully requested, for the rejection of the claims as unpatentable over CROWE et al. in view of DALMIA et al.

The claimed invention is a method for testing the behavior of a solid material submitted to cyclic variations of temperatures in the presence of a gaseous atmosphere, whereas CROWE discloses a method for characterizing a material.

The objects of CROWE and the present invention are very different.

CROWE's method intends to determine the chemical composition of a material (nature and proportion of its components). To this end, CROWE proposes observing the transitions (physical or chemical transformation, phase change, structural change...) that a material sample shows while increasing progressively the temperature. The transitions are detected by measuring weight variations of the sample. The presence of a component leads to the occurrence of a transition at a given temperature. The nature and the quantity of the components of the material can thus be deduced from the temperatures at which transitions occur and from the weight loss

or gain of the sample at these temperatures.

The main object of the behavior test of the present invention is to predict the behavior of a material under given conditions of use, and especially under important cyclic variations of temperature in the presence of a non-inert (for example, oxidizing, corrosive, dehydrating...) gaseous atmosphere, in order to determine the material resistance under these conditions, its life duration, fissuring risks, the maximum temperature of use of the material, etc.

For a person skilled in the art, a method for characterizing a material such as CROWE's method is totally irrelevant and inefficient for determining the behavior of the material under given conditions of use including cyclic temperature variations. A person skilled in the art wishing to improve known behavior tests or to invent a new behavior test would thus not even consult CROWE.

In the present invention, the samples are subjected to successive predetermined thermal cycles, whereas in CROWE's method, the heating rate is <u>a function of the current measured weight</u> of the sample.

As explained in the present specification, in the claimed method, the thermal cycles arc <u>initially determined</u> (as regards duration of each cycle, duration of each step of a cycle, maximum and minimum temperatures, heating and cooling rates...) according to the real conditions of use of the material, in order

to predict the behavior of the material under these real conditions. For example, when it is possible and relevant, the cycles or some of their steps can be chosen such as to reproduce as far as possible the real thermal conditions of use of the material.

On the contrary, in CROWE's method, the heating rate is continually adjusted according to the measured weight of the sample so as to impose, on the one hand, a low heating rate (about 1°C/minute for example) during a transition of the material in order to improve resolution and, on the other hand, a higher heating rate (between 50 to 100°C/minute) through temperature regions with no transition in order to reduce the total duration of the test. The thermal conditions of the test (current temperature, heating rates, durations...) are thus determined as the test goes on, according to the current weight of the sample.

It is to be noticed that CROWE's method normally includes a single heating step; however, it can also include a cooling step or eventually a plurality of thermal cycles (each including heating and cooling steps). But in any case, the heating or cooling rate is continually regulated according to the measured weight.

For this reason, CROWE's method does not allow predicting the behavior of a material under given aggressive cyclic thermochemical conditions.

In none of the examples described in CROWE are the samples subjected to thermal cycles each including a heating step with a high-temperature stage (during which the temperature is maintained constant) and a cooling step. Actually, in all these examples, the samples are subjected to a single heating step, from ambient temperature to a final temperature above 800°C. For this single heating step, the heating rate is set to a maximum heating rate (for example 50°C/min) in periods with no transition and to a minimum heating rate (for example 2.7% of the maximum rate, that is to say 1.35°C/min) during a transition of the material. This single heating step is only comprised of a phase of rise in temperature; it does not include any temperature stage (which would correspond to a temperature change equal to zero). Contrary to the opinion expressed in the Official Action, 37 minutes in Example 2 is not the duration of a high-temperature stage but the total duration of the test (single phase of rise in temperature from ambient temperature to 800°C).

This difference between CROWE's method and the claimed invention is important. Indeed, such a high-temperature stage is useless in CROWE's characterizing test but is fundamental (and new) in the behavior test of the claimed invention. The inventors have demonstrated that these high-temperature stages allow predicting the behavior of the material in a very reliable manner. In particular, when applied to the study of oxidation, they allow for the first time measuring the mass of oxide formed

at each thermal cycle, the mass of oxide lost by cracking at each thermal cycle and the oxide-forming kinetics, for the following reasons:

- as demonstrated by the inventors, the oxide—forming kinetics are maximum during high-temperature stages, so that these stages are useful to predict the duration of life of a material:

- the influence of Archimede's buoyancy remains the same and thermal streams are negligible during a high-temperature stage, so that the weight gain measured between the beginning and the end of a high-temperature stage is the real weight gain of the sample; it corresponds to thee mass of oxide formed during the stage;

- if the temperatures of the high-temperature stages of two successive cycles are chosen to be equal (same influence of the Archimede's buoyancy during the two stages), the weight loss measured between the end of the first stage and the beginning of the following second one is the real weight loss of the sample; it corresponds to the mass of oxide lost by cracking during the first cycle;

- the recording of the sample weight in a continuous manner during a high-temperature stage allows calculating the oxide-forming kinetics during this stage, as the measured weight variations are the real weight variations;

- <u>direct</u> heating of samples during heating steps allows

choosing high heating rates (in particular more than 100°C/min) for the phases of rise in temperature. The inventors have demonstrated that the mass of oxide formed during a phase of rise in temperature is negligible at such a heating rate, so that the mass of oxide formed during the high-temperature stage can be assimilated to the total mass of oxide formed during the whole cycle.

And all the preceding comments remain valid as for the study of cyclic thermal corrosion, dehydration, passivation, adsorption, decomposition, pyrolysis, dehydroxylation, combustion, etc.

With CROWE's method, none of these parameters (mass of oxide formed or lost, oxide—forming kinetics...) can be measured or calculated. That is also why CROWE's method is totally useless to predict the behavior of a material under given cyclic conditions of use.

Furthermore, CROWE does not disclose a method and a device wherein a plurality of samples are simultaneously tested.

DALMIA does not remedy the deficiencies of CROWE. DALMIA discloses an instrument for measuring weight, comprising a pan, an enclosure around said pan, and a hang-down wire coupled to said pan and to a weight sensor. The object of DALMIA is to reduce error when measuring minute quantities of weight by reducing the volumes of the pan and the hang-down wire, by choosing appropriate materials for the pan and the hang-down

wire, and by choosing a carrier gas having consistent density over changes in temperatures.

DALMIA does not disclose a method for testing the behavior of a material under given cyclic thermal conditions; it does not disclose a method including subjecting samples to predetermined thermal cycles; it does not disclose cycles with high-temperature stages; and it not disclose a device for simultaneously testing a plurality of samples.

Thus, none of the differences between the claimed invention and CROWE is taught or even suggested by DALMIA or by any other cited prior document. Consequently, it cannot be obvious to one having ordinary skill in the art to modify CROWE's method according to the claimed invention.

As the claims in the case clearly bring out these distinctions with ample particularity, it is believed that they are all patentable, and reconsideration and allowance are respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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